

Design and Analysis of Wiping type Bending Tool for Lever Draft Control- A Review

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Abstract— The product made up of sheet metal is used in every field in our day today life. to make such a sheet metal product we must perform various type of cutting and non-cutting operation on the sheet metal product unless and until we get final product in our hand. For making such a product a variety of technics are available in the market which is used to make a sheet metal product are manually, hydraulically, pneumatically operate press tool are available in the market and selection is done as per the requirement. In bending operation, the Lever draft control product of hot rolled carbon steel grade-d material in the form of flat sheet is uniformly strained around a linear axis which lies in the neutral plane & perpendicular to the lengthwise direction of the sheet. In this tool the cad model and Analysis is done in solid work software version 19, In this bending tool the product allowed by the Industries (Bhagyashri Home Appliances Pvt. Ltd) then the wiping operation has to be perform on the Lever draft control product, after wiping type bending operation, the welding fixture is design to join the two lever draft control product to give lap joint between the two in solid work software, after designing, the structure analysis is done on the wiping type bending tool & thermal analysis is done on the welding type fixture tool on lap joint in solid work software itself.

Keywords— *Product design, bending tool design, welding fixture design, structural analysis, thermal analysis, solid works 19.*

1. INTRODUCTION

The press tool is a special tools custom built to produce component mainly out of sheet metal, product made up of sheet metal is used in every field in our day today life. to make such a sheet metal product we have to perform various type of cutting and non-cutting operation on the sheet metal product unless and until

we get final product in our hand. For making such a product a variety of technics are available in the market which is used to make a sheet metal product are manually, hydraulically, pneumatically operate press tool are available in the market and selection is done as per the requirement.

In bending operation, the Lever draft control product of hot rolled carbon steel grade-d material in the form of flat sheet is uniformly strained around a neutral axis which lies in between the neutral plane & perpendicular to the bend axis of the sheet. In the wiping type bending tool, the lever draft control type sheet metal product is stretch on the specific area only. This specific area is called bend area which is lies on the bend line which is also called bend axis, in this bend area the inner surface gets squeeze and show compressive stress and outer surface get expanded and show tensile stress. The sheet metal product gets effected at this particular area only and other area not get effected.

In this tool the cad model and Analysis is done in solid work software version 19, In this bending tool the product allowed by the Industries (Bhagyashri Home Appliances Pvt. Ltd) then the wiping operation has to be perform on the Lever draft control product, after wiping type bending operation, the welding fixture is design to join the two lever draft control product to give lap joint between the two in solid work software, after designing, the structure analysis is done on the wiping type bending tool & thermal analysis is done on the welding type fixture tool on lap joint in solid work software itself.

2. LITERATURE REVIEW

1. S.B. Gaikwad] discussed in their paper “Design and Development of compound die” (2019) that the project mainly focuses on compound die design for existing operations to replace the current progressive die wherein the die contributed to increasing in the production rate, reduction of production cost and the time cycle from 30 to 40 sec using suitable design being done in Solid works and Analysis of the press tool being done in Ansys
2. Pawan Kumar Rai “Causes & Prevention of Defects (Burr) In Sheet Metal Component” (2013) has discussed the imperfections that are common in the sheet metal industry which after a specified limit it takes the form of defect. Also different Chances of failure in Manufacturing & Assembly of Tool, need of material hardness, clearances and alignment of components are discussed.
3. Gaurav C. Rathod et in “Study and Analysis of Press Tool Design” develop a press tool for Piercing and notching made for sheet metal component. It shows a study of force reduction method used while designing the die and to ensure excellent geometrical compatibility of the mechanical press and the designed combined press tool. They also discuss a detailed study of various materials to be used for different components of the die, depending upon their importance, the efficiency of the die and the various factors affecting them.
4. Subramanian et al [4] in “Design and Analysis of Press Tool to Produce Radiator Stay Bracket” (2016) mostly focus on the designing of press tool to be used in the production of the stay bracket, also modelling of all the components, and analysing the stress and deflection on the components. In “The design and fabrication of a compound die to make hexagonal washer” the authors N. JYOTHIRMAYI et al [5] presented the design and fabrication of a compound die that combines blanking and piercing operations. Detailed calculations for Press capacity, plate thickness, Punching, and blanking forces as well as spring calculations were shown. The successfully designed die is being currently used in the Metal Forming Lab of Chaitanya Bharathi Institute of Technology, Hyderabad.
5. V. Senthil Raja. Conclude in this paper, a bicycle integrated pipe bending mechanism has been designed and developed. The applications of bent pipes are in frames, barricades, handle of bicycle. Most of industries uses bent pipes as air conditioning, boiler, power generation, ship building, furniture, railroad, automotive, off-road and farm equipment, aircraft etc. Due to adequate human power in countries like India, the human powered machine will result in improvement of the economy and employment of nation. In Asian countries people are facing electricity cut-off during most of the days so such system plays an important role in rural areas.
6. Akbar h khanetal conclude in this paper gives information about newly designed and developed manual pipe bending machine.it states that the machine can bend pipes of various thickness. These bent pipes have large applications in industries.it summaries the information about construction of pipe bending machine the machine the pipe in different angle and also at different shape.
7. Mr.sayyed Qasim conclude in this paper that sheet metal forming that in bending of sheet has major role and contribution in many mechanical industries especially automobile industries and transportation companies in terms of improvement or development. The most common sheet forming process is the bending process this also called as metal working manufacturing process.
8. N.N. jadeja in this paper state for small pipe machine user industries. For bending a 19mm outer and 17 mm inner diameter pipe can bend with the accuracy without any wrinkle inside the pipe and failure with the help of the machine.
9. A. D. Zope in this study state in this paper is to design, development and analysis of metal bending machine. The machine is able to bend the sheet into curve shape .it shape that the size of machine is so convenient that it can be easily transported from one place to another the material used for production of machine is MS. Hence it is easy to carry from one place to other.it reduces human effort and increases accuracy.

10. Shantanu Garad in this paper present methods for bending rod, pipe and metal strips are of great significant for modern job order type production workshops. The situation where the workshop owner can't afford different machines for different application such as for pipe bending. So this machine is become an option for such type of workshops.
11. Veronica Geraldine Zaragoza in this paper state the design of hybrid systems as rapid tools consisting of a polymeric part and a metallic framework has been introduced in the sheet metal bending process as a new solution. The rapid tool setup has been compared with commercial metal tools alternatives, typically used in the sheet metal bending industry. The experimental results demonstrate that the performance of the rapid tools is similar to that of metallic tools solution, once the punch stroke is adjusted. Using the same process parameters, the rapid tools show similar values of bend angles without any aesthetical defects (like scratches) on the product surface, contrary to the defects observed for the specimens bent with the metal solution. The results obtained show that the V-shaped cavities made of polymeric materials are stable and, if loaded at low stress, the tool life is sufficient to promote the use of these cost-efficient tools for small batch industrial productions.
12. N. E. Hansen and O. Jannerup[1] focused on the geometric understanding of three roller beam bending process by assuming triangular moment distribution between rollers. The main aim of the research was to obtain more accurate geometrical model to control the bending process. The model was formulated to find the position of top roller corresponding to desired curvature function. Sensitivity of geometrical model to variations in machine geometry and material characteristics was also investigated. The work was limited to bending of beams based on simple theory of bending of beams.
13. Qiulei Du state in this paper has carried on the detailed calculation and checking aiming at main components of bending machine. Through complicated, accurate calculation can bring great convenience to choosing components precisely so as to guarantee the machine running in good condition, avoid wear and tear caused by some certain problems, and thus increase machine's service life. Calculation and check aim at workbench, wallboard and connecting bolts. Bending machine in the design is of convenient mould replacement, accurate positioning rear stopper and easy adjusting front carrier. Users only need moulds in different shapes to bend them into required shapes. Further it adopts advanced and reliable electro-hydraulic synchronization technology, which is able to guarantee high synchronization accuracy even under the action of partial residual. It is ideal for sheet metal forming, can be widely used in aircraft, automobile, shipbuilding, electrical appliances, machinery and light industry, and the production efficiency is quite high.
14. Jie Wang state in this paper a new flexible sheet metal bending process method was proposed and a flexible sheet metal bending equipment was designed to solve the common problems in the current sheet metal bending process. The forming process of the bending process was simulated by finite element method, and the simulation results were compared with those of the bending tooling bending process. The simulation results showed that the bending quality of sheet metal bending structure parts was obviously better than that of bending tooling, and many problems in bending tooling production were solved.
15. Siddesha K in this paper This paper addresses the fixture design verification issue. In this paper, the work piece location, clamping stability, deformation, stresses and strains in the component due to clamping load are taken into account. Even the stress and strain in the component due to clamping load is also considered. Concluding contributions of this paper in the area fixture design are Fixture design for welding process, and its manufacturing considerations Locating, clamping and work piece mounting with respect to welding process Analysis of the component.
16. Neeraj Kumar Jha in this paper state that on obtained analysis results, it can be stated that the designed fixture is a feasible design based on considerations. Such fixtures are easy to manufacture at less cost and quite convenient to use. Thus, they can be suitably implemented to ease the efforts of the welder. As well as the fixture can serve as a part of academic and experimental set up for analysis of different methods of welding over

various metals. The research work in this paper shows welded joints on flat plates but the same fixture can be utilized for obtaining joints on similar profiled plates for industrial applications.

17. Shailesh S. Pachbhai in this research paper state the efficiency and reliability of the fixture design has enhanced by the system and the result of the fixture design has made more reasonable. To reduce cycle time required for loading and unloading of part, this approach is useful. If modern CAE, CAD are used in designing the systems then significant improvement can be assured. To fulfil the multifunctional and high-performance fixturing requirements optimum design approach can be used to provide comprehensive analyses and determine an overall optimal design. Fixture layout and dynamic clamping forces optimization method based on optimal fixture layout could minimize the deformation and uniform the deformation most effectively. The proposed fixture will fulfil researcher production target and enhanced the efficiency, Hydraulic fixture reduces operation time and increases productivity, high quality of operation, reduce accidents.
18. Yuguang Wu et.al (2008)(1) has derived that this paper presents Automated modular fixture planning based on linkage mechanism theory. We studied from this paper; Modular fixture is a kind of very promising flexible fixture device in manufacturing. It is also used in assembly and verification process. The modular fixture is able to deal to with the work piece with irregular shape by combining modular fixture elements. Therefore, the flexibility and response capability of manufacturing system can be improved. However, modular fixture planning is a very difficult problem, especially for the modular fixture with the dowel pin system as the locators of such modular fixtures can only be inserted into the fixed doweled holes. That is why modular fixture planning is still performed by fixture designers in industries up to now, relying on designer's experiences and trial and error method. The main problem with manual planning of modular fixtures lies in that it is almost impossible for a designer to enumerate all the alternative fixture plans, which makes it extremely hard to find out the optimal fixture plan. Obviously, it hinders the use of modular fixtures with dowel-pin system in industries. One way to solve the above problems is to use computer to assist designers in performing modular fixture planning.
19. Chanada Naksri in this research aims to design a welding fixture that can adjust angled using AHP to obtain the most suitable welding fixture assembly for the application. The thermal properties analysed by Finite Element Analysis (FEA) were also used, it was found that the designed welding fixture was not affected by heat during welding. As a result, the fixtures can hold the workpiece efficiently as expected. Device results, especially Jig fixture designed to press the workpiece from the vertical with a twist the clamping force of 7-9 pounds can hold the workpiece to resist the shrinkage of welding and does not cause the workpiece to be deformed or damaged, which can be obtained from the design principles of the Jig fixture. For other research approaches or to further carry out this research, the end of gripping should be taken into account. Equipment weight, and by combining the device with a practical welding table, can perform more versatile and ergonomic work.
20. Xiuping Ma state in this study the simulation results of different line constraint clamping schemes show that applying line constraints near the weld can effectively reduce the axial deformation of the outer ring of the flame cylinder and the highest residual stress. Applying different pressures near the line clamping constraint can reduce the axial deformation and improve the residual stress distribution, but the radial deformation will increase. When the applied pressure exceeds 60 MPa, the excessive applied pressure will cause instability and deformation in the thin-walled parts.
21. N. P. Maniar, D. P.Vakharia(2012) presented design of rotary fixture for industrial usage which has been proved to save millions of rupees. As these operations are performed in their project were grooving, outside diameter turning, boring, back facing, etc. Actually, they say the HMC was the best machine to perform these operations, but it costs too high as compared to CNC turning centres, hence they have designed a fixture which can be used for CNC turning centres which will ultimately save millions of rupees. They have mainly focused on calculating the unbalanced masses on the rotary fixture. In this paper, they have also provided alternate.

22. Rupesh Desale in this paper have overviewed Welding Fixtures, Welding Joints, Welding Defects and CO2 arc welding. also analysed about the parameters and properties affect welding of joints and welding defects.
23. Seloane state in this paper the conceptual design of the intelligent reconfigurable welding fixture that defines the RMS and its principle was developed. Furthermore, an intelligent fixture design that enhances the 4th industrial thinking was established. Precise welding assembly with less scrap rate, improved versatility to meet frequent market changes was achieved with this intelligent fixture design. The development of IRWF improved quality of parts products, setup time and production cost. The room for mistake when utilising the IRWF is minimal. Full synchronization of the IRWF with the robotic welder reduced the setup time was achieved. The involvement of the human operator when using the IRWF is minimal.
24. Naveen A Conclude in this paper the Design and Analysis of Welding Fixture for Motor Case Assembly in this paper for motor case assembly is approximately about 4-meter length of assembly. which have welded for the brackets and ducts on the motor case assembly. the required tolerances on the motor case assembly the shaft/support pipe is designed as a main part of the welding fixture and the different parts are mounted on this shaft /support pipe. The analysis is carried out to have an optimum shaft dimension it's minimum deflection they have a proper clamping in fixture all parts of motor case assembly. All the analysis part is carried out using CATIA V5 R17 and All the modelling of the components has been carried out using UNIGRAPHICS NX8.0. The optimum shaft/support pipe of outer diameter 200mm and 184mm inner diameter has been derived from the theoretical calculations and it's same subjected to analysis for the stress and deflection error was found to be 5.6% and 4.94% respectively.
25. C. A. Kubade, Dr. S.V. Patil have explained in their paper that in manufacturing industry, fixtures have a direct impact upon product manufacturing quality, productivity and cost. Welding fixtures are designed for the components which are difficult to weld in normal way or without any holding unit. The fixture is to be designed for the cab leg sub-assembly which is to be welded with its companion for its application. The investigation involves study of basics of fixture and welding, need of fixture, location principle. In this work, welding fixtures are designed considering all the welding factors like access to its welding area, cycle time, and availability of space for fixture. Materials are selected as per functional requirements and based on previous designs. The general arrangement is made and fixture is designed with the use of analytical method which includes pneumatic cylinder selection, L-shaped bracket design and positioning of units. Power clamps and LM guides are selected as per the fixture requirements. The design is verified with the use of FE analysis for strength criteria of material and is found under safety limits.
26. Jigar D Suthar Studied Drum mix plant used for mixing of concrete and other raw materials used in road construction. Impeller is used in the exhaust system of drum mix plant to remove dust particles. Fixture is used in manufacturing of impeller during welding to hold the different parts of the impeller assembly like blades(vanes), upper and lower plates. This paper shows an innovative way to use impeller structure itself as fixture and which has been resulted in the reduction of distortion produced during welding. In this paper modelling work has been done using AutoCAD, Pro-e, Solid Works software, and analysis part has been done using ANSYS workbench. Hence the design and analysis of the fixture has been presented in this paper. Unbalance mass for the impeller has been reduced to 44g for the new design from 100g for the existing design. Proper selection of tolerance has been done by cut out some experimental specimen which shows that proper tolerances for the fixtureless design are H7/f7 and H8/e8. For reducing welding distortion and for proper cooling of weld, small and intermittent slots have been provided rather than longer slot. From comparison that has been made of various process namely laser cutting, plasma cutting, and punch press used for sheet metals required for impeller assembly, it is found that punch press is better than plasma cutting and laser cutting in terms of energy related cost saving. Manufacturing lead time is less in fixtureless

design because of less welding area, less assembly time and no fixturing requirement.

27. S. N. Shinde Robotic welding requires specialized fixtures to accurately hold the work piece during the welding operation. Despite the large variety of welding fixtures available today the focus has shifted in making the welding arms more versatile, not the fixture. The new fixture design reduces cycle time and operator labour while increasing functionality; and allows complex welding operations to be completed on simple two axis welding arms. The process of conducting operations related to welding fixtures and positioners helps in gaining a deeper understanding as well as effective project process. The prototype construction proves fruitful in analysing the process for its potential as a finished product. In today's market all large manufacturers are automating as much of their production line as possible. Automated processes have been in high demand extensively in past two decades but there is still room for improvement. Welding fixtures closes the gap in the engineering of automated fixture mechanism. From finding a resource for research material to design updates of the part causes the task of accurately prototyping the real design difficult. It is important that the design satisfies all of the functional requirements and design parameters which were outlined at the start of the project. In order to meet the requirements of the fixture customization is done by making the clamping system very practical for various sizes and geometries. A few other considerations for calculations that would ultimately improve the quality of the welding fixture are stress analysis and cost benefit analysis. Stress analysis and friction analysis would both help in the selection of material to be used for each part of the machine. Thorough stress calculations could not be done without knowledge of the material being used for each part, because of different materials physical and mechanical properties. By also knowing the material selection a cost benefit analysis could be conducted to determine how cost effective the product is. All of these calculations would greatly add to the significance of the research already conducted.
- 28 Yuvraj R study in this paper the effect of clamping on welding distortion of the Bogie Frame

assembly is investigated in this paper. Finite Element Analysis (FEA) Analysis predicted an unfavourable welding distortion, and a corrective measure was implemented to control the distortion. Optimum clamping force has been calculated which required for controlling the welding distortion. Welding distortion analysis can be used to predict behaviour and distorted shape by evaluating the effects of the fixtures. Such forecasting is useful information for the manufacturer in identifying potential distortion issues and making decisions about manufacturing strategy and fixture structure during the design phase. After successful Design and Analysis, the Welding fixture has been manufactured and has been implemented at the shop floor. This welding fixture used for accurate assembly of the child parts with required tolerances, as well as helps in reduction of production loss and also manufacturing lead time for welding, positioning and holding parts.

- 29 G. C. Jadhav in this study proposed fixture has been designed, developed and tested successfully on universal milling machine (BFU-5).It possesses the strength to sustain downward load acted by the spindle force against its structure The advantage of utilizing the existing milling machine by adopting the application of fixture for FSW process can be justified economically, where it is more affordable compared to purchasing an actual FSW machine.
- 30 M C Mittal et al have experimented successfully on the GTA (Gas Tungsten Arc) welding of maraging steel using the copper back-up plate with the purging facility to analyse the fracture toughness.

3.CONCLUSION

The Lever draft control product of hot rolled carbon steel grade-d material in the form of flat sheet is uniformly strained around a neutral axis which lies in between the neutral plane & perpendicular to the bend axis of the sheet. and in welding fixture is a type of fixture which is characterized in operation type of fixture, in this fixture lever draft control weld in welding fixture. The joint which is used to connect the two component of lever draft control are lap joint which is used to give permanent joint between the two lever draft component.

In this tool the cad model and Analysis is done in solid work software version 19, In this bending tool the product allowed by the Industries (Bhagyashri Home Appliances Pvt. Ltd) then the wiping operation has to be perform on the Lever draft control product, after wiping type bending operation, the welding fixture is design to join the two lever draft control product to give lap joint between the two in solid work software, after designing, the structure analysis is done on the wiping type bending tool & thermal analysis is done on the welding type fixture tool on lap joint in solid work software itself.

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